UNITED STATES AERONAUTICS AND SPACE ACTIVITIES, 1961

MESSAGE

FROM

THE PRESIDENT OF THE UNITED STATES

TRANSMITTING

A REPORT ON UNITED STATES AERONAUTICS AND SPACE ACTIVITIES FOR THE CALENDAR YEAR 1961, PURSUANT TO SECTION 206(b) OF THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958, AS AMENDED

JANUARY 31, 1962.—Referred to the Committee on Science and Astronautics and ordered to be printed

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U.S. GOVERNMENT PRINTING OFFICE

79165 WASHINGTON : 1962

Chapter IV
Department of Defense

INTRODUCTION

In 1961, military space activity expanded both in volume and scope as the Department of Defense (DOD) sustained a vigorous interest in the advancement and exploitation of space technology for the enhancement of the national defense posture. Space efforts of the Department are integrated with the over-all military program, supplementing or complementing other military activities.

Some of these space efforts are systems oriented in those areas which are definable today such as navigation and communications. Others are oriented toward the development of future space capabilities such as rendezvous and inspection. Finally, there are developments in basic technology, the building blocks necessary for a flexible capability to move rapidly into systems needed in the future as specific defense requirements and missions are defined. These building blocks include structures, guidance and control systems, maneuverable re-entry vehicles, propulsion, and man himself.

Many significant accomplishments were achieved in the military portion of the national space program during 1961. The United States Military Space Detection and Tracking Center (SPADATS) attained full operational status. SPADATS is an essential element of the North American Air Defense Command's Combat Operations Center. Nuclear power sources, developed through the Atomic Energy Commission, were used for the first time in space to power TRANSIT navigational satellites. LOFTI, the very low frequency satellite, launched pick-a-back on TRANSIT, provided data to confirm that the ionosphere is not opaque to very low frequency radio energy. Three satellites were launched simultaneously on a single space booster. The technology and technique of recovering capsules from orbit was improved.

Space activities of the military departments are closely coordinated by the Director of Defense Research and Engineering. On March 6, 1961, the Secretary of Defense issued a directive assigning a primary responsibility for military space research and development to the Department of the Air Force. Exception is made, however, in any case where the particular interests, responsibilities, or unique capabilities of one of the other military departments properly justifies a specific assignment. Current examples are the Navy's navigational satellite program, TRANSIT, and the Army's communications satellite project, ADVENT.

In addition to the space programs conducted by the Department of Defense, planning for potential military applications of the future must also take into account all aspects of research and development in space. This is essential to insure that all of the technology and techniques already developed, being developed, or planned for development, are incorporated into national defense plans and programs.

For these reasons, and because the NASA programs help make our country stronger in many fields of science and technology, the DOD and NASA operate in close accord at management and operating levels to insure that the collective efforts are complementary.

The NASA-DOD Aeronautics and Astronautics Coordinating Board continued to function effectively during the year to ensure close working relationships and to effect integration of DOD and NASA effort essential to the prosecution of a single national space program. Through the Board membership and six functional area panels, projects and project support were defined, planned, revised, and adjusted to eliminate duplication, and to apportion, adjust, or augment effort as required.

Major DOD programs and joint planning efforts are discussed in following sections:

MAJOR PROGRAMS

ADVENT

The objective of this program is to demonstrate the feasibility of instantaneous microwave communications using an active repeater in a synchronous equatorial orbit. This program calls for the placing of communications satellites in orbits 19,300 nautical miles above the earth where they will rotate at the same rate as the earth and remain fixed with respect to the ground. This satellite is designed to meet military communications requirements of security and resistance to jamming and interception. Two ground stations are nearing completion at Fort Dix, New Jersey, and Camp Roberts, California. The initial launches next year call for the placing of satellites in 5,000-mile orbits, utilizing the ATLAS AGENA B as a preliminary step. The following year orbiting at the synchronous altitude may be possible. Three such satellites, properly spaced in equatorial orbit, could provide instantaneous communications between almost any two points in the world. ADVENT ground stations will also be used to support the NASA SYNCOM communications satellite program.

ARENTS

The ARPA Environmental Test Satellite (ARENTS) project is a task under the VELA HOTEL program. Its objective is (1) to investigate the space environment at the 24-hour orbit altitude of 19,300 nautical miles, (2) to measure the fluctuations of this environment with time, and (3) to determine the long-term behavior of critical satellite-system components in this environment. The ARENTS data will be of general scientific value and will support other space programs, especially those such as the Army ADVENT communications satellite program which will operate in a 24-hour orbit. Of particular interest to VELA HOTEL are experiments to measure the radiation background.

The ARENTS spacecraft is scheduled to fly with a NASA payload on three of the ten CENTAUR vehicle development flights. The mission assignments of these vehicles are under review.

EAMBI (PROJECT DEFENDER)

The purpose of this program is to conduct research necessary to identify and

solve the problems involved in intercepting enemy ballistic missiles during or immediately after the burning phase. The program derives its name from BAllistic Missile Boost Intercept.

As presently foreseen, the BAMBI concept involves high performance space-based platforms and interceptors. The conceptual and preliminary investigations to date have not established feasibility or firm values for design and operational parameters. Detailed technical assessments of the work to date indicate that considerable additional research is required in a variety of areas before the technical, operational, and economic feasibility of the BAMBI concept can be verified.

BLUE SCOUT

The BLUE SCOUT program is directed toward providing a simple, reliable and versatile space booster system which can be used to perform selected, lightweight space missions for much less cost than the larger ballistic missile-derived boosters. The family of BLUE SCOUT vehicles utilizes standard hardware developed by NASA. With certain modifications and developments, and by combining various size solid propellant booster stages, flexibility is provided to match a wide variety of military requirements.

During 1961 there have been seven launches of the BLUE SCOUT family, of which five were successful in achieving their design mission. The successful shots placed various probes to altitudes from 1,000 to 56,000 nautical miles. Both of the failures occurred shortly after lift-off and were destroyed by the range safety officer.

DISCOVERER

The Air Force has continued a vigorous DISCOVERER satellite program during the past year. The program consists of testing components, propulsion, guidance systems, and techniques used in various U.S. space projects. Included is the gathering of scientific data in such areas as space radiation, cosmic rays, micrometeorites, radio wave propagation, biomedicine, temperature, pressure, density, and general engineering using both recoverable and non-recoverable packages. Capsule recovery is foremost among techniques being studied.

Seventeen launches were attempted this year with twelve satellites attaining orbit successfully. Of that number, seven have been recovered from orbit. Four of these were caught in the air by specially equipped aircraft and three by parachute dropped rescue teams equipped with scuba diving gear. There have been a total of 36 DISCOVERER launches to date. Impact predictions and recovery techniques have been steadily improving with the accumulation of knowledge and refinement of equipment. The C-130B aircraft have now replaced the slower and lower flying C-119s for recovery missions.

The AGENA B, second stage and satellite vehicle which is currently being used, is also being employed or planned for use in other Air Force programs such as MIDAS, SATELLITE INSPECTOR, and some of the NASA programs. Action has been initiated to develop and test a standardized AGENA, the AGENA D, for future use by the Air Force and NASA. The testing of this vehicle has been assigned to the DISCOVERER program.

DYNA-SOAR

DYNA-SOAR is a manned test vehicle capable of maneuverable re-entry from orbit to a conventional controlled landing at an air base which can be selected by the pilot.

The development is a joint USAF-NASA program, financed and administered by the Air Force, to construct and test a manned military space research vehicle which will explore the problems and conditions of hypersonic flight over the range between the X-15 research aircraft and orbital velocity. The program will demonstrate the capability for positive, pilot controlled re-entry and recovery from orbit. The pilot of the DYNA-SOAR glider will have the ability to control his return to Earth by extending his flight path by several thousand miles straight ahead or to either side followed by conventional landing. This will enable the pilot to select the time when he will initiate re-entry and to control the point where he will land.

During 1961, design details of the DYNA-SOAR glider were finalized culminating in a full scale mockup of the vehicle and its subsystems in September. Wind tunnel testing of the glider-booster combination has been nearly completed and sub-contracts for development of the high temperature nose cap, flight control electronics, auxiliary power system, reaction controls, acceleration (abort) rocket, environment (cockpit) control system, generators and test instrumentation have gotten well under way. Other contracts for guidance, communications and data link subsystems are also in effect. Current program progress indicates that the development is proceeding on schedule and confidence has increased in the successful attainment of program objectives.

GREB

The Naval Research Laboratory's Solar Radiation Research Satellite, GREB III, was launched pick-a-back on TRANSIT IV A, on June 29, along with INJUN I. Due to a malfunction in the mechanism connecting GREB and INJUN these two satellites are orbiting the earth still connected together. Despite this malfunction, however, GREB III has emulated its predecessors in providing continuous information on solar activity in the X-ray and ultraviolet radiation bands. These data are correlated with other ionospheric and ground level measurements in order to determine the effects of solar activity on radio and radar propagation, weather activity, and related phenomena.

LOFTI

Launched pick-a-back on TRANSIT III B on February 21, the Naval Research Laboratory's Very Low Frequency Satellite, LOFTI, opened a whole new field of scientific investigation that may lead to significant advances in military communications and space vehicle navigation. From data gathered during LOFTI's six week lifetime in space, Navy scientists have been able to confirm their belief that the ionosphere is not opaque at low frequencies, as previously assumed, and that VLF radio waves pass through the ionosphere into the exosphere with relatively little attenuation. This information points, among other uses, to the possible use of trans-ionospheric VLF radio waves emanating from ground stations as navigational aids to manned or unmanned space vehicles and,

conversely, to the possibility of world-wide communications with VLF communications.

MIDAS

The objective of the MIDAS program is the development of a reliable satellite-borne missile defense alarm system. The MIDAS system will consist of a net of satellites equipped with infrared payloads which can detect ballistic missiles during the powered phase of their ascent trajectory.

During 1961 the third and fourth MIDAS flight vehicles were launched into successful, high altitude orbits from the Pacific Missile Range. Valuable vehicle performance and infrared data were obtained from these orbital flights.

MIDAS IV, launched on October 21, carried pick-a-back the Project WEST FORD package containing 75 pounds of very small copper dipoles imbedded in naphthalene. The dipoles were to have dispersed in space to form an earth-girdling belt for communications relay. There has been no evidence that the dipoles spread as scheduled. Occasional radar contacts have been made with an object in space thought to be the WEST FORD package but causes for failure of the experiment are, as yet, speculative.

Rocket Probes

During this year the DOD made extensive use of instrumented rocket probes for research in the upper atmosphere and space environment. Experimental objectives ranged from purely scientific to the determination of features of the natural environment directly influencing material design and operational performance.

Vehicles employed included the NIKE-CAJUN, AEROBEE, ASTROBEE, EXOS, and ARCAS sounding rockets. In addition, seven development test shots of the BLUE SCOUT vehicle were made with research payloads on board. Payloads weighing from 40 to 200 pounds were carried aloft to altitudes between 40 and 700 miles. A few of the more important scientific results of these programs included:

a. The acquisition of a high resolution ultraviolet spectrum of the sun by an AEROBEE rocket carrying newly designed instrumentation which demonstrated an order of magnitude improvement over previous techniques for mass spectroscopy by sounding rockets.

b. The measurement of absolute radiation fluxes in the ultraviolet region of the 40 brightest stars.

c. The discovery of what appears to be a dense band of micro-meteorites encircling the earth at altitudes of about 100 miles. This dust, of barely visible particle size, was measured at densities of about 10 particle impacts per second per square centimeter.

SATELLITE INSPECTOR

Work continued on a SATELLITE INSPECTOR program. During March 1961 contracts were let to design, fabricate and test the SATELLITE INSPECTOR spacecraft. This program will, in the near future, provide the United States the capability to rendezvous in space with selected objects and to inspect them. The DOD and NASA are closely coordinating their efforts in the field of space rendezvous technology and both the SATELLITE INSPECTOR and manned space flight programs should benefit from anticipated advances in this field.

SPADATS

On July 1, 1961 the Space Detection and Tracking Center at Ent Air Force Base, Colorado, became operational. This center, operated by the Air Defense Command for NORAD, is the heart of the Space Detection and Tracking System over which CINCNORAD assumed operational control during the latter part of last year. While the ability to detect, track, and catalog space objects is still limited, the system now in being has a real capability in this area.

In June of 1961 the addition of a new transmitting station to the Navy Space Surveillance System (NAV SPASUR) raised the detection ceiling of this NORAD SPADATS element from a previous 1000 miles to a present capability in excess of 3000 nautical miles. NAV SPASUR is currently reporting in excess of 20,000 observations per month on the more than one hundred objects (satellites and assorted "space junk") currently orbiting the earth.

During 1961 action was initiated to develop both optical and radar sensor for space surveillance which will give the military services a capability to detect and track space objects well beyond current ranges. Such sensors will be integrated into automatic systems capable of completely processing these observations for tactical evaluation in a matter of seconds after an object is first detected.

TRANSIT

The TRANSIT satellite navigation system developmental program is progressing as planned on a schedule directed toward the availability of this system for worldwide fleet operational employment in the last quarter of calendar year 1962. During 1961 principal research efforts were concentrated on increased system reliability and accuracy, the refinement of refraction and geodetic data, satellite power and stabilization technology, and the development of shipboard navigation equipment.

There were three TRANSIT satellite launches during 1961:

a. TRANSIT III B: Launched from the Atlantic Missile Range on February 21 into a highly elliptical orbit (536 nautical mile apogee and 94 nautical mile perigee) inclined 28.5 degrees to the equator. The Naval Research Laboratory's very low frequency research satellite LOFTI I was launched pick-a-back with this experiment. Despite a poor initial orbit and the failure of the LOFTI satellite to separate, both caused by launch vehicle malfunctions, TRANSIT III B

effectively demonstrated the requisite capability for data injection, storage, and retransmission before burning up on re-entry on March 30.

b. TRANSIT IV A: Launched from the Atlantic Missile Range on June 29 into a near-circular (500 nautical mile) orbit inclined 67.5 degrees to the equator. This launch achieved the first "triple-decker" payload launch and the first utilization of a nuclear power source for satellite auxiliary power. TRANSIT IV A and its pick-a-back companions, the Naval Research Laboratory's solar radiation research satellite, GREB III, and the State University of Iowa's space research satellite, INJUN I, are still in orbit and fully functional.

c. TRANSIT IV B: Launched from the Atlantic Missile Range on November 15 into a near-circular (500 nautical mile) orbit inclined 32.5 degrees to the equator. TRANSIT IV B again carried aloft the AEC's SNAP III type nuclear auxiliary power source. Carried pick-a-back with this equipment was an additional payload called TRAAC (Transit Research and Satellite Control) designed by the Applied Physics Laboratory, of the Johns Hopkins University to explore a method by which satellites could be stabilized in space by natural gravitational forces. Other instrumentation is providing data on several of the space environmental factors which will influence satellites' lifetimes and operational performance.

The launch of TRANSIT IV B marked the last planned launch of a TRANSIT satellite by the THOR-ABLE-STAR vehicle used to date in this program. All future launches are programmed for SCOUT vehicles to be launched by the Air Force. During 1962 all TRANSIT launch activity will be shifted to the Pacific Missile Range.

When operational the TRANSIT system will provide reliable, world-wide, all-weather navigation for ships of all nations to a degree of accuracy (1/2 mile or less) heretofore unattainable with conventional navigational methods. To insure that world-wide commercial shipping can avail itself of this mode of navigation, the Navy is coordinating with appropriate organizations.

VELA HOTEL

The Department of Defense Project VELA consists of programs of research, experimentation and systems development for improving the detection of nuclear explosions both underground and at high altitude. It is subdivided into three research and development programs:

a. VELA UNIFORM: detection of underground nuclear explosions;

b. VELA SIERRA: ground-based detection of nuclear tests in space; and

c. VELA HOTEL: satellite-based detection of nuclear tests in space.

VERA HOTEL is a joint DOD/AEC program. Its objective is to confirm experimentally detector sensitivity, reliability, and system performance capability in the space environment by conducting experiments to obtain data on the background effects of the natural radiation environment in space. Of particular interest are possible natural radiations in space which might be similar to those expected from a nuclear detonation in space. The progress consists of pick-a-back flights on vehicles scheduled for other space programs and high altitude flights of spacecraft designed specifically for VELA HOTEL. In the former category -- pick-a-back -- are instrumentation packages developed by the AEC Lawrence Radiation Laboratory and the Los Alamos Scientific Laboratory to be flown on DISCOVERER, RANGER, BLUE SCOUT JR, and ATLAS missiles. In the latter category -- high-altitude spacecraft flights -- five launches during 1963-64 are planned. Each launch will consist of two spacecraft which will be injected into circular orbits at altitudes of about 50,000 nautical miles, and separated by about 140 degrees. The ATLAS/AGENA B booster combination will be used, and final injection into orbit will be accomplished by an injection motor included in the spacecraft. The payload will consist of X-ray, gamma-ray and neutron detectors.

X-15 Research Aircraft

Program Objectives

The X-15 research aircraft program will gather needed scientific and engineering data on manned hypersonic flight for application in future aerospace systems.

Progress

The X-15 program, a joint endeavor of the USAF/NASA/Navy, was initiated in the spring of 1952. At this time, the NASA directed its team to study problems likely to be encountered in flight beyond the atmosphere and recommend methods to explore the problems. Very early in 1954 a team was assigned by NASA to determine the characteristics of an airplane capable of exploratory flight studies and the feasibility of building such an airplane. In June 1954, NASA representatives met with the Air Force and Navy to develop a program. In December 1955, a contract was let for the construction of three airplanes. The first X-15 was completed in October 1958, and made the first captive flight on March 10, 1959. Since the first powered flight on September 1959, a continuing research program has been in progress. To date, the flight envelope has been expanded to flight conditions of 6,005 feet per second (speed) and 217,000 feet (altitude) to validate design criteria.

Flight Summary

As of December 18, 1961, there had been 45 flights (launches) of the X-15 aircraft. The planned performance was achieved on 42 of those flights, and the prime research objective was achieved on 40 of those flights. A 98% launch success has been achieved on the X-15 aircraft. The success is attributed to the use of alternate modes for subsystems